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BMBP:FW

December 9, 1954

Mr. Saul J. Harris
Associate Radio-Physicist
Department of Labor
State of New York
80 Centre Street
New York 13, N. Y.

Dear Mr. Harris:

This will refer to your letter of November 16, 1954 requesting information on a list of radioisotopes which may be considered "safe" for general distribution.

The list to which you refer was prepared for the consideration of a subcommittee of the National Committee on Radiation Protection for inclusion in Part 4 of a report on the regulation of radiation exposure by legislative means. A draft of this portion of the report was issued in November 1954 and was given limited circulation for purposes of eliciting comment. If you have available a copy of this draft, the list of radioisotopes to which you refer is given on page 23. The proposed Chapter XVI of the New York State Sanitary Code gives approximately the same list on pages 3 and 4. There is one difference in the two lists. The latter list gives the value of one microcurie for natural thorium and natural uranium while the NCRP list gives a value of 1000 microcuries for these two radioisotopes. The reason for this difference will appear in the following discussion.

The limits given in this list were obtained by estimating the maximum quantity of each isotope which could be taken into the body at one time without causing some organ or tissue of the body to be exposed in excess of one of the following levels:

(1) 10 r in 24 hours
(2) 25 r in 3 months
(3) 50 r in 1 year
(4) 150 r in 10 years
(5) 250 r in 25 years

These values are somewhat arbitrary inasmuch as they have not been previously answered by any authoritative group in the field of radiation control. However, they are believed, on the basis of existing information, to be well below the hazardous range and were considered reasonable by the NCRP.

Since exposure may occur either by ingestion or by inhalation, and since the organ receiving the limiting dose may be the "critical" organ of the body listed in NBS Handbook 52 or may be the lung or the gut, this method of selecting the limiting quantity is developed by estimating the quantity required to reach one of the levels listed above under each of the following four conditions,

(1) critical organ by ingestion
(2) critical organ by inhalation
(3) direct exposure of lung, and
(4) direct exposure of gut

and then selecting the smallest of these quantities as the limiting quantity for that radioisotope.

Computations are based on the values given by K. Z. Morgan in Nucleonics, June 1954 (Reference 1) and in the draft Report of K. Z. Morgan to the International Commission on Radiological Protection, 1953 (Reference 2). The values in Reference 1 are adapted to the present purpose by first converting the concentrations listed to quantities which would be ingested or inhaled in 24 hours, using 200 ml/day as the normal rate of intake of water and 2×10^7 cm/day as the normal rate of intake of air, and then computing by use of the equation,

$$Q = \frac{q_0}{\lambda} (1 - e^{-\lambda t}),$$

the quantity which would be required to give the dose of interest.

The actual computations are somewhat tedious and I have only one copy of the detailed results. However, if you are interested in further detail, I shall be glad to supply it.

The computations as made indicate that the limiting quantities of uranium and thorium on this basis should be somewhat less than one microcurie. However, because of the physical difficulty of taking a microcurie of the material into the body within a short period of time as the result of an accident, it was the judgment of the Subcommittee that these two materials should be assigned to the 1000 microcurie group.

Very truly yours,

Forrest Western
Biophysics Branch
Division of Biology and Medicine

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